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Qualitative Analysis of Fundamental Theoretical Tools Employed in Modelling Decision Making Problems

by

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Abstract

The objective of this paper is to analyze fundamental theoretical tools employed in modelling decision making problems which involve multivariate risks. By exploiting the richness of the literature, we highlight the qualities as well as the “weaknesses” specific to a wide class of decision models. These are not free from critiques, especially when real world problems are considered. A little effort has been spent on improving this type of models, often conceptually convenient but not always adequate. This study emphasizes the need for a consistent framework to cover a broad area of research on the strategic behavior of potentially risk-averse policy-makers in a controlled dynamic stochastic environment. Work remains to be done in this exciting area.

JEL classification: C10, C51, C52, C53, P51.

Keywords: Active (passive) learning, Rational decision-maker, Closed-loop (open-loop) strategy, Stochastic (deterministic) control, Numerical (analytical) solutions, Reversible decisions, Increasing uncertainty, Risk-aversion.

Résumé

L’objectif de cet article est d’analyser des outils théoriques fondamentaux utilisés dans la modélisation des problèmes de prise de décision qui intègrent des risques multivariés. En exploitant la richesse de la littérature, nous mettons en évidence les qualités ainsi que les “faiblesses” spécifiques à une large classe de modèles de décision. Ce ne sont pas exempts des critiques, en particulier si des problèmes complexes sont considérés. Peu d’effort a été investi sur l’amélioration de ce type de modèles, souvent conceptuellement commodes mais pas toujours adéquats. Cette étude fait ressortir la nécessité d’un cadre cohérent pour couvrir un large domaine de recherche sur le comportement stratégique des décideurs potentiellement

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risk-averse dans un environnement dynamique stochastique contrôlé. Du travail reste à faire dans ce domaine passionnant.

Classification JEL: C10, C51, C52, C53, P51.

Mots-clés: Apprentissage actif (passif), décideur rationnel, Stratégie en boucle fermée (ouverte), Contrôle stochastique (déterministe), Solutions numériques (analytiques), Décisions réversibles, Incertitude croissante, Aversion pour le risque.

1. Introduction

We often ascertain in the decision making literature models which are not free from critiques, especially when real world problems are considered. An implication of an inappropriate modelling is the divergence between theoretical results and empirical findings. More general models could provide greater robustness being less restrictive but they have greater modelling difficulties. The advantage of allowing a much broader structure consists in more appropriate decisions taken by policy-makers. However, difficulties emerge when computational costs are taken into account. In this article we analyze and compare qualitative theoretical tools employed in the context of decision theory, providing a consistent review of the existing literature. In doing so, we focus on their advantages and limitations, the purpose being to emphasize the need for a consistent framework which better describe decision problems under risk and uncertainty. Section 2 presents the learning advantages in the context of a dynamic stochastic system and compares active learning with passive learning. Section 3 discusses the concept of rationality and highlights its “weaknesses”. Section 4 analyzes two types of strategies often employed in problems of decision and control, namely the closed-loop and respectively open-loop strategies. Section 5 examines the role of numerical solutions for dynamic programming models and compares these with analytical solutions generally obtained in more restrictive conditions. Section 6 treats several types of decisions employed in the context of stochastic optimization problems. Section 7 deals with several types of aversions encountered in the decision making process and points out important characteristics of environmental policy-making problems, given that in this area of research the development of specific formal tools is very awaited. Section 8 concludes and discusses possible future work.

2. Active Learning versus Passive Learning

Learning is one of the three aspects (beside the parametric uncertainty and stochasticity) of the economic agent’s uncertainty problem and has many dimensions. This can take place at various levels of a policy problem, ranging from economic agents who are learning in order to adapt to changes in the environment to policy-makers who are trying to formulate the best policy (i.e., a rule for choosing an optimal action at each point in time) in an uncertain and changing world. An optimal behavior may arise from a process of learning. We recall here